3D chemical mapping by EFTEM and XANES tomography using EFTEM-TomoJ.

Messaoudi C[1,2*], Aschman N[1,2], Cunha M[1,2], Oikawa T[3], Sorzano CO[4], Conesa JJ[4], Chiappi M[4], Pereiro E[5], Chichón FJ[4], Carrascosa JL[4], Marco S[1,2]

[1]*Institut Curie, Centre de Recherche, 26 rue d'Ulm, 75248 Paris Cedex 05, France*
[2]*INSERM U759, Campus Universitaire d'Orsay, Bât. 112, 91405 Orsay cedex France*
[3]*JEOL Ltd., 1-2Musashino 3-chome, Akishima, Tokyo 196-8558, Japan*
[4]*National Center of Biotechnology(CSIC), c/Darwin, 3. Campus Univ. Autónoma de Madrid. 28049 Cantoblanco, Madrid, Spain*
[5]*CELLS - ALBA, Carretera BP 1413, de Cerdanyola del Vallès a Sant Cugat del Vallès, Km. 3,3 08290 Cerdanyola del Vallès, Barcelona Spain*

Electron tomography is becoming one of the most used methods for structural analysis at nanometric scale in biological and materials sciences. Combined with chemical mapping, it provides qualitative and semiquantitative information on the distribution of chemical elements on a given sample. Due to the current difficulties in obtaining 3D maps by EFTEM, the use of 3D chemical mapping has not been widely adopted by the electron microscopy community. An alternative to EFTEM is recover X-ray absorption near-edge structure (XANES) information using synchrotron X-ray sources to determine the distribution and concentration of elements in biological materials. This approach can be combined with tomography yielding a quantitative 3D map of the distribution of the interesting element within the sample.

Here we present a software package (EFTEM-TOMOJ) [1], specifically dedicated to computation of 3D chemical maps by EFTEM and near-edge structure (XANES). The software includes image series alignment, noise filtering by image reconstitution based on multivariate statistical analysis, different background subtraction models and a new algorithm named BgART allowing the discrimination between background and signal for improving the reconstructed volume in an iterative way.

References:

1. Messaoudi C. Aschman N. Cunha M. Oikawa T Sorzano COS. Marco S. (2013) EFTEM-TomoJ: 3D chemical mapping by EFTEM including SNR improvement by PCA and volume improvement by noise suppression during the ART reconstruction process. Microsc. Microanal. 28:1-9.